SERIES 275

MINI-CONVECTRON® VACUUM GAUGES WITH LINEAR ANALOG OUTPUT AND CE CONFORMANCE

INSTRUCTION MANUAL

GRANVILLE-PHILLIPS
HELIX TECHNOLOGY CORPORATION

INSTRUCTION MANUAL

SERIES 275
MINI-CONVECTRON
VACUUM GAUGES
WITH LINEAR ANALOG OUTPUT

YOU SHOULD READ THIS INSTRUCTION MANUAL BEFORE INSTALLING, USING, OR SERVICING THIS EQUIPMENT

This manual is for use only with Series 275 Mini-Convectron Vacuum Gauges with the following part numbers:

275850-EU	275851-EU	275852-EU	275853-EU
275854-EU	275855-EU	275856-EU	275857-EU
275858-EU	275859-EU	275862-EU	(20)275953-PD,PK,PP-T
(20)275580-GQ	(20)275557-EU		

CERTIFICATION

Granville-Phillips Company certifies that this product met its published specifications at the time of shipment from the factory.

LIMITED WARRANTY

This Granville-Phillips Company product is warranted against defects in materials and workmanship for one year from the date of shipment provided the installation, operating and preventive maintenance procedures specified in this instruction manual have been followed. Granville-Phillips Company will, at its option, repair, replace or refund the selling price of the product if GPC determines, in good faith, that it is defective in materials or workmanship during the warranty period, provided the item is returned to Granville-Phillips Company together with a written statement of the problem.

Defects resulting from or repairs necessitated by misuse or alterations of the product or any cause other than defective materials or workmanship are not covered by this warranty. GPC EXPRESSLY DISCLAIMS ANY OTHER WARRANTY, WHETHER EXPRESSED OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. UNDER NO CIRCUMSTANCES SHALL GRANVILLE-PHILLIPS COMPANY BE LIABLE FOR CONSEQUENTIAL OR OTHER DAMAGES RESULTING FROM A BREACH OF THIS LIMITED WARRANTY OR OTHERWISE.

Instruction Manual 275539 Rev 01

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CONTENTS

WARNING

Danger of injury to personnel and damage to equipment exists on all vacuum systems that incorporate gas sources or involve processes capable of pressurizing the system above the limits it can safely withstand.

For example, danger of explosion in a vacuum system exists during backfilling from pressurized gas cylinders because many vacuum devices such as ionization gauge tubes, glass windows, glass bell jars, etc., are not designed to be pressurized.

Install suitable devices that will limit the pressure from external gas sources to the level that the vacuum system can safely withstand. In addition, install suitable pressure relief valves or rupture discs that will release pressure at a level considerably below that pressure which the system can safely withstand.

Suppliers of pressure relief valves and pressure relief discs are listed in Thomas Register under the respective headings "Valves, Relief" and "Discs, Rupture".

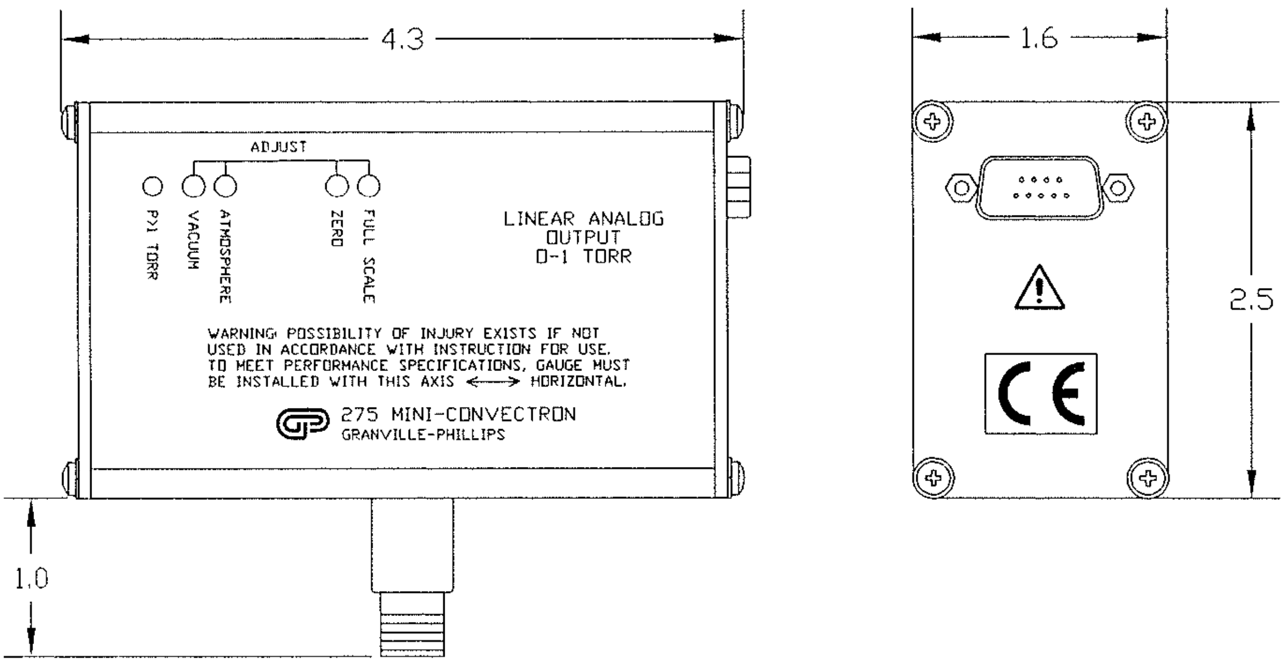
WARNING

275 Convectron gauges are intended for use only on vacuum systems which have suitable devices installed that will limit the pressure from external gas sources to the level the system can safely withstand and which also have suitable pressure relief valves or rupture discs installed. Confirm that these safety devices are properly installed before installing the Convectron gauge. In addition, check that (1) the proper gas cylinders are installed, (2) gas cylinder valve positions are correct on manual systems, and (3) the automation is correct on automated systems.

SPECIFICATIONS

Measurment Ranges:	Bridge output: 1 mTorr to 1,000 Torr nonlinear. Linear output: Zero to 1,000 mTorr minimum.
Output voltage:	Bridge output: +0.375 Vdc to +5.659 Vdc nonlinear corresponding to 0 to 1,000 Torr for N_2 (1 ohm output impedance). Linear output: Zero to +10 Vdc minimum corresponding to 0-1000 mTorr minimum for N_2 (1 ohm output impedance).
Ambient operating temperature range:	+4 to +50 °C.
Gauge tube temperature compensation range:	+15 to +50 °C.
Bakeout temperature range (non-operating):	85 °C max. with electronics attached.
Electrical power:	+12.5 Vdc to 26.5 Vdc @ .1 Adc. Protected against reversals, transients or over-voltages. 1.6 watts maximum.
Gauge tube:	
Internal Volume:	40 cm^3 (2.5 in^3).
Sensor:	Gold plated tungsten.
Weight:	0.198 kg (0.438 lb)

Physical size: (full scale)



CHAPTER 1

SAFETY INSTRUCTIONS

SAFETY PAYS, THINK BEFORE YOU ACT. UNDERSTAND WHAT YOU ARE GOING TO DO BEFORE YOU DO IT. READ THIS INSTRUCTION MANUAL BEFORE INSTALLING, USING, OR SERVICING THIS EQUIPMENT. IF YOU HAVE ANY DOUBTS ABOUT HOW TO USE THIS EQUIPMENT SAFELY, CONTACT THE GRANVILLE-PHILLIPS PRODUCT MANAGER FOR THIS EQUIPMENT AT THE ADDRESS LISTED ON THIS MANUAL.

Explosive Gases

Do not use the gauge tube to measure the pressure of combustible gas mixtures. The sensing element normally operates at only 125 °C, but it is possible that momentary transients or controller malfunction can raise the sensor above the ignition temperature of combustible mixtures which might then explode causing damage to equipment and injuring personnel.

Limitation on use of Compression Mounts

Do not use a compression mount (quick connect) for attaching the gauge tube to the system in applications resulting in positive pressures in the gauge tube. Positive pressures might blow the tube out of a compression fitting and damage equipment and injure personnel. The Series 275 gauge should not be used above 1000 Torr or 1333 mbar true pressure.

Tube Mounting Position

If the gauge tube will be used to measure pressures greater than 1 Torr, the tube must be mounted with its axis horizontal. Although the gauge tube will read correctly below 1 Torr when mounted in any position, erroneous readings will result at pressures above 1 Torr if the tube axis is not horizontal. Erroneous readings can result in over or underpressure conditions which may damage equipment and injure personnel.

Overpressure

Series 275 gauges should not be used above 1000 Torr true pressure. Do not use above 1000 Torr true pressure. Series 275 instruments are furnished calibrated for N_2. They also measure the pressure of air correctly within the accuracy of the instrument. Do not attempt to use a Series 275 gauge calibrated for N_2 to measure or control the pressure of other gases such as argon or CO_2, unless accurate conversion data for N_2 to the other gas is properly used. If accurate conversion data is not used or improperly used, a potential overpressure explosion hazard can be created under certain conditions.

A pressure relief valve should be installed in the system should the possibility of exceeding 1000 Torr (1333 mbar) exist.

Electrical

Before connecting your Mini-Convectron to a power source, be sure that the source is compatible with the power requirements listed.

Electrical Power Requirements

DC voltage source +12.5 Vdc to +26.5 Vdc @ 0.1 Adc max.

Chemical

Cleaning solvents, such as trichloroethylene, perchloroethylene, toluene and acetone produce fumes that are toxic and/or flammable. Use only in areas well ventilated to the outdoors and away from electronic equipment, open flames, or other potential ignition sources.

Sensor Failure

If the gauge tube sensor wire fails, the output voltage will indicate below 0 mTorr.

Tube Contamination

The calibration of the gauge will be seriously affected by any gases which will attack the gold plated sensor and could result in overpressurizing the system. Two primary gases in this category are mercury vapor and fluorine.

CHAPTER 2

INSTALLATION INSTRUCTIONS

Receiving Inspection

Domestic Shipments

Inspect all material received for shipping damage.

Confirm that your shipment includes all material and options ordered. If materials are missing or damaged, the carrier that made the delivery must be notified within 15 days of delivery in accordance with Interstate Commerce regulations in order to file a valid claim with the carrier. Any damaged material including all containers and packing should be held for carrier inspection. Contact our Customer Service Department, 5675 Arapahoe Avenue, Boulder, Colorado 80303, (303) 443-7660 if your shipment is not correct for reasons other than shipping damage.

International Shipments

Inspect all material received for shipping damage. Confirm that your shipment includes all material and options ordered. If items are missing or damaged the carrier making delivery to the customs broker must be notified within 15 days of delivery.

Example:

> If an airfreight forwarder handles the shipment and their agent delivers the shipment to customs the claim must be filed with the airfreight forwarder.
>
> If an airfreight forwarder delivers the shipment to a specific airline and the airline delivers the shipment to customs the claim must be filed with the airline, not the freight forwarder.

Any damaged material, including all containers and packaging, should be held for carrier inspection. Contact our Customer Service Department, 5675 Arapahoe Avenue, Boulder, Colorado 80303, U.S.A. Telephone (303) 443-7660 if your shipment is not correct for reasons other than shipping damage.

Important Precautions for Mini-Convectron Installation

The following precautions in the use and installation of the Mini-Convectron must be observed.

1. It is recommended that the Mini-Convectron be installed with the port oriented vertically downward to ensure that no system condensates or other liquids collect in the gauge tube. The gauge tube axis must be horizontal if it is to be used at pressures above 1 Torr. Although the gauge tube will read correctly below 1 Torr when mounted in any position, erroneous

readings will result at pressures above 1 Torr if the tube axis is not horizontal.

2. Do not use a compression mount (quick connect) for attaching the Mini-Convectron to the system in applications resulting in positive pressures in the gauge tube. Positive pressures might blow the tube out of a compression fitting and damage equipment and injure personnel. Pipe thread or flange mounting systems should be used for positive pressure applications. In any case, the absolute pressure in the tube should not exceed 1000 Torr.

3. Do not perform electrical continuity tests on the Mini-Convectron tube with instruments applying voltages in excess of 1 volt when the tube is at vacuum, or 5 volts when at atmospheric pressure. Exceeding these voltages will damage the sensing element.

4. Keep the tube clean. Do not remove the mounting port cover until you are ready to install the tube.

5. Do not mount the Mini-Convectron in a manner such that deposition of process vapors, upon the internal surfaces of the gauge tube, may occur through line-of-sight access to the interior of the gauge tube.

6. Do not install the Mini-Convectron where high amplitudes of vibration are present. Excessive vibration will cause forced convection at high pressure giving erroneous readings.

7. Do not bake the Mini-Convectron with electronics attached at temperatures exceeding 85 °C.

8. Do not install the gauge tubes where they will be subject to corrosive gases such as mercury vapor or fluorine which will attack the gold plated sensor.

9. For greatest accuracy and repeatability the Mini-Convectron tube should be located in a stable room temperature environment.

10. The port of the Mini-Convectron is not grounded. Installation should be only to grounded systems if lethal voltages are present in the system.

11. All connections to the unit are to be made with shielded cable or cables. The shield or shields are to be connected to the connector shell.

Gauge Tube Construction

The transducer is a convection enhanced Pirani gauge providing rapid response, six-decades of pressure transduction, stable calibration, and good accuracy. The Pirani sensing element, R1 of the schematic of Fig. 2-1, is one leg of a Wheatstone Bridge. A temperature compensating network, R2, forms the second leg of the bridge. The temperature sensitive component of this network is mounted inside the gauge tube envelope with the sensor. All other resistors of the bridge are mounted upon the exterior electrical feedthrough pins of the gauge tube. Pin 4 serves as an electrical terminal for construction of the compensating network, R2, but no connection is made therefrom to the controller.

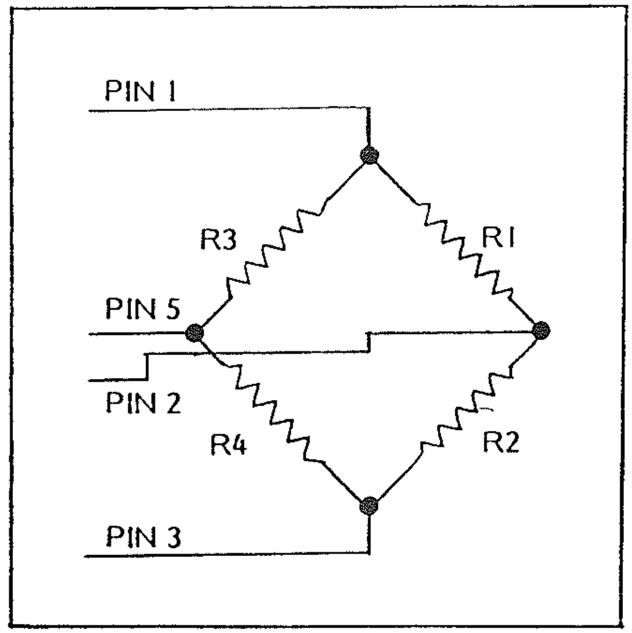


FIG. 2-1 GAUGE TUBE SCHEMATIC

All materials have been chosen for ultra high vacuum service, corrosion resistance and bakeability to 150 °C. The gauge tube envelope is type 304 stainless steel. All metallic joints in the envelope are TIG welded. No solder is used within the envelope. The following materials are exposed to the vacuum: Type 304 stainless steel, Carpenter Alloy 52, Kovar,[1] Kapton®, gold plated tungsten and borosilicate glass.

[1]Trademark of Carpenter Technology

Mini-Convectron Gauge Tube Orientation

It is important to consider the orientation of the Mini-Convectron if an accurate reading above 1 Torr is necessary to prevent overpressure or for other reasons.

Below 1 Torr: The Mini-Convectron will operate and accurately read pressures below 1 Torr when mounted in any orientation. Above 1 Torr: The Mini-Convectron will accurately read pressures above 1 Torr only when mounted with its axis horizontal, preferably with the port pointing vertically downward. It is valuable to point the port downward to facilitate the removal of condensation and other contaminants.

Installation

The Mini-Convectron is designed to be installed by use of the side port fitting only. Adequate strain relief should be incorporated for the I/O connector.

1. Compression Mount (Quick Connect)

   Do not use for positive pressure applications.

   The gauge tube port is designed to fit a standard 1/2 in. compression (quick disconnect) mount such as the Cajon Co. Ultra-Torr® fittings.

   Remove the caplug from the gauge tube port, insert the gauge tube port into the compression fitting and finger tighten the press ring. If a seal is not achieved it is likely due to extreme cleanliness of the O-ring. A light film of vacuum grease, such as Apiezon,[2] will ensure sealing and is normally preferable to the use of pliers or pipe wrench to further tighten the press ring, You may point the electrical pins of the Mini-Convectron anywhere you wish in a 360 degree horizontal circle for optimum routing of the cable.

2. 1/8 NPT Mount

   The threads on the Mini-Convectron port will fit a standard 1/8 NPT female fitting. Wrap the threads of the gauge tube port with Teflon® tape and screw these threads into the system fitting hand tight. Do not use any wrench or tool. The Mini-Convectron body functions adequately as its own wrench. Tighten only sufficiently to achieve a seal. When the threads have been tightened to the point where a seal is just achieved, about one-half turn additional tightening is all that can be gained without overstressing the tube port.

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[2]Trademark of James G. Biddle Co.

3. Other Mounts

In addition to the standard 275810 gauge tube which provides a 1/2 in. compression mount and 1/8 NPT male thread, a variety of other mounting options are available. They include rotatable 1-5/16 in. and 2-3/4 in. Conflat type flanges, Cajon® VCO® and VCR® type fittings and NW10KF, NW16KF, NW25KF, NW40KF, and NW50KF flanges.

I/O Connector Wiring

The 9 pin "D" type connector has the following pin assignments:

Pin No.	Function
1	External cal in
2	External cal out
3	Power input +12.5 Vdc to +26.5 Vdc @ .1 Adc max.
4	Power ground
5	Bridge analog output voltage
6	No connection
7	No connection
8	Signal ground
9	Linear analog output voltage

NOTES

CHAPTER 3

OPERATING INSTRUCTIONS

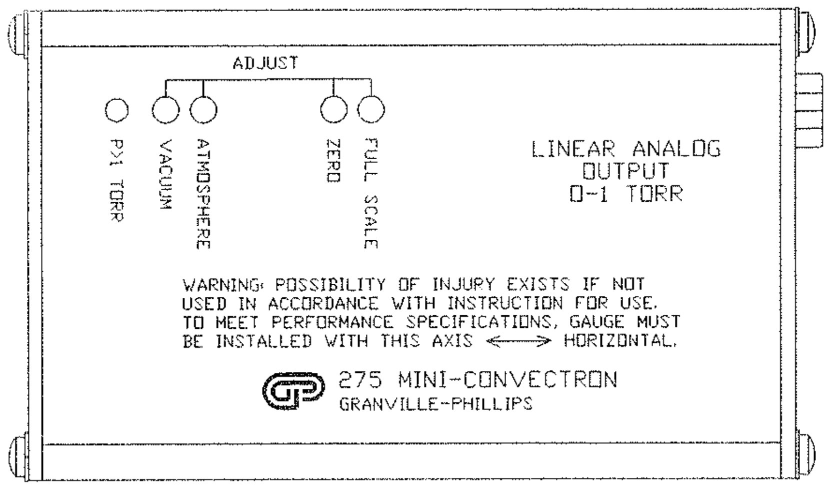


Fig. 3-1 Front Panel Indicator and Adjustments

Purpose of Front Panel Features

P > 1 Torr Indicator - A red light emitting diode is used as a rough pressure indicator. The LED will be OFF below 1 Torr and gradually turn on as pressure increases.

Vacuum Adjustment - Adjustment is provided to restore accuracy of the bridge analog output voltage at low pressures.

Atmosphere Adjustment - Adjustment is provided to set the bridge analog output voltage to correspond to known atmospheric pressure.

Zero Adjustment - Adjustment is provided to restore acuracy of the linear analog output voltage at low pressure.

Full Scale Adjustment - Adjustment is provided to calibrate the linear analog output voltage for the gas type selected.

Bridge Analog Output

Fig 5-4 is a chart of the bridge analog output voltage for various gases. The impedance of this output is 1 ohm. This output is normalized for 0.375 Vdc at vacuum and 5.534 Vdc at 760 Torr for N_2 or air.

Analog Output Linear

Fig. 5-5 is a graph of the linear analog output for various gases. The impedance of this output is 1 ohm. This output is normalized for 0.000 Vdc at vacuum and +10.000 Vdc at 1 Torr for the gas selected. Normal calibration is for N_2 or air.

Long Cable Operation

There is no restriction on cable length since the control circuitry is located right at the sensor. This is true as long as the input voltage remains within the range specified.

Bakeout

The Mini-Convectron is designed to allow bakeout temperature of up to 85 °C with the electronic circuitry attached but not operational.

Power

The Mini-Convectron is in operation anytime that the input power is applied. The sensor of the gauge tube runs at a temperature of approximately 120 °C. Gauge tube life is not affected by hours of operation.

CHAPTER 4

CALIBRATION

Each Mini-Convectron gauge tube is individually calibrated for N_2 and temperature compensated prior to leaving the factory. Each controller is individually calibrated to provide accurate readout of N_2 or air pressure; therefore, initial calibration should not be necessary. See Chapter 5 for use with gases other than N_2 and air. If the tube becomes contaminated or does not read correctly, the Mini-Convectron can be calibrated with the front panel adjustments by performing the following steps, in order.

1. <u>Vacuum Adjust</u>

   a. Evacuate the system to a pressure less than 10^{-4} Torr.

   b. While monitoring the bridge analog output voltage adjust the vacuum potentiometer for a reading of +0.375 Vdc.

2. <u>Atmosphere Adjust</u>

   a. Allow the system pressure to rise to atmospheric pressure of air.

   b. While monitoring the bridge analog output, adjust the atmosphere potentiometer for a voltage corresponding to the absolute pressure corresponding to your location. Refer to Fig. 4.1 for typical altitude/Torr/voltage relationships.

Altitude in Feet Above Sea Level	Pressure In Torr (N_2,Air)	Analog Output Voltage Vdc
0	760	5.534
1000	733	5.513
2000	707	5.493
3000	681	5.473
4000	656	5.454
5000	632	5.435
6000	609	5.417
7000	586	5.399
8000	564	5.382
9000	543	5.366
10,000	523	5.350

Fig. 4-1

Zero Adjust

1. Complete the vacuum adjust from page 4-1.

2. While monitoring the linear analog output voltage, adjust the zero potentiometer for a reading of 0.000 Vdc.

Full Scale Adjust

1. Method "A" - Using a known accurate standard:

   a. Using the accurate standard as a reference raise the pressure in the system by backfilling with the gas type in use to approximately 1 Torr.

   b. Adjust the full scale potentiometer for a linear analog output voltage that corresponds to the output of the standard where 1 Torr = 10 Vdc.

2. Method "B" - Using the 1 Torr bridge output voltage from Fig. 5-4.

   a. Raise the pressure in the system by backfilling while monitoring the bridge analog output voltage. Stabilize at a voltage corresponding to the 1 Torr data from Fig. 5-4 for the gas selected.

   b. Adjust the full scale potentiometer for a linear analog output voltage of 10.000 Vdc.

CHAPTER 5

USE WITH GASES OTHER THAN N_2 AND AIR

It is important to understand that the analog output voltages from a Series 275 Mini-Convectron depends on the type of gas in the tube, on the orientation of the tube axis, and on the gas pressure in the tube. Series 275 Mini-Convectrons are supplied calibrated for N_2 when the axis of the gauge tube is horizontal. The indicated reading for air is the same as for N_2 within the accuracy of the instrument. With certain safety precautions, the Series 275 Mini-Convectron may be used to measure pressure of other gases.

Series 275 Mini-Convectron gauges are thermal conductivity gauges of the Pirani type. These gauges transduce gas pressure by measuring the heat loss from a heated sensor wire maintained at constant temperature. For gases other than N_2 and air the heat loss is different at any given true pressure and thus the analog output voltage will be different.

Bridge Analog Output Voltage

Figs. 5-2 and 5-3 show the relationship of true pressure for N_2 (air) - vs - bridge analog output voltage. This graph was plotted using the data taken from Fig. 5-4 which is the bridge analog output voltage versus true pressure for various gases. This data can be used in your application by performing a curve fit for the gas involved with your process. It can also be plotted out on the graphs of Figs. 5-2 and 5-3 if you desire to see how it compares with N_2 or air.

For gases not listed, or for a mixture of gases, it will be necessary to generate your own calibration curve using an acceptable gas independent transfer standard such as a capacitance manometer. The maximum usable bridge analog voltage output will depend upon the input voltage used. Subtract 4 Vdc from VIN to determine the maximum analog voltage output. This will determine the highest readable pressure for the gas involved.

Linear Analog Output Voltage

Fig. 5-5 shows the relationship of true pressure for various gases vs. linear analog output voltage. From this data a close approximation of true pressure for a gas can be calculated without the need to actually recalibrate the unit. Similar to an ion gauge tube we can determine a relative gas sensitivity constant which can be used to determine the true pressure of a gas for a unit calibrated for N_2 or air. The following chart can be used for the gases indicated:

Gas Type	Average Relative Sensitivity(s)
Krypton	.41
Argon	.61
Neon	.73
Helium	.93
CO_2	.95
Oxygen	.97
N_2, Air	1.00
Freon 22	1.18
Freon 12	1.22
D_2	1.37
CH_4	1.56

$$\textit{True pressure} \quad \textit{milliTorr} = \frac{\textit{Linear analog output VDC}\ (100)}{S}$$

External Calibration

It is possible to accomplish the full scale calibration of the linear analog output external to the Mini-Convectron for use in a system where multiple gases are being switched. By varying the feedback resistor of the final amplifier from a nominal of 10 KΩ, we can compensate for the relative gas sensitivity shown in Chapter 5. Use a rotary switch or multiple relays to switch in the following approximate resistance value for the gas in use.

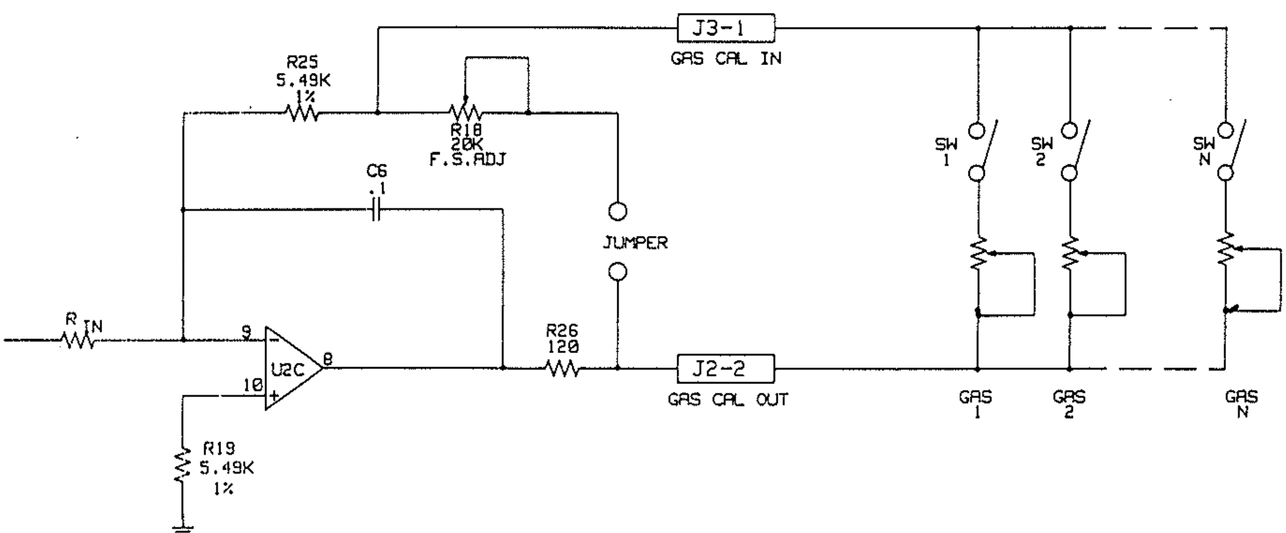


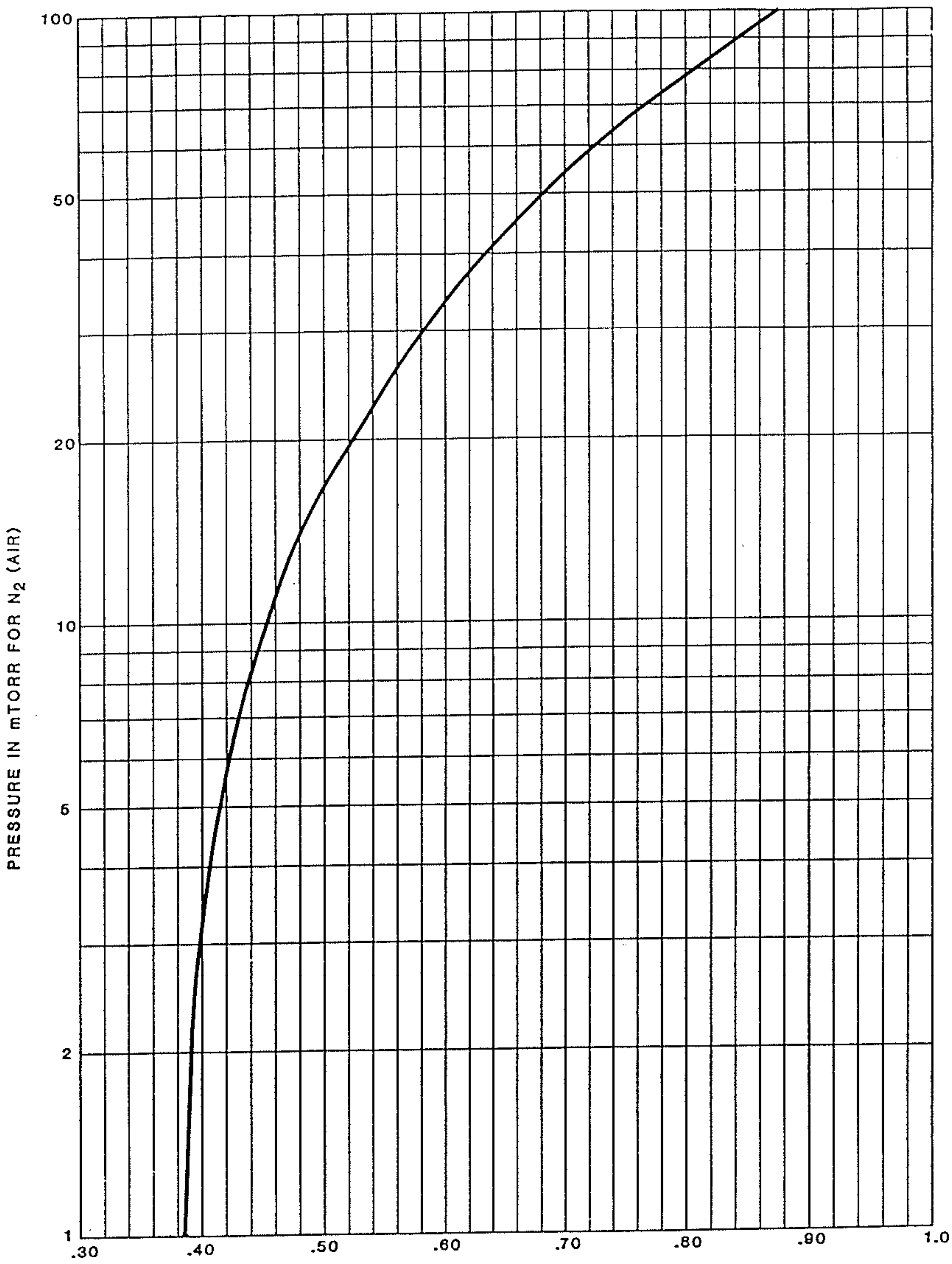
Fig. 5-1 Schematic, External Calibration

Gas Type	Approximate R Value	Less R25 = 5.49K
Krypton	24.3K	18.81K
Argon	16.5K	11.01K
Neon	13.7K	8.21K
Helium	10.7K	5.21K
CO_2	10.5K	5.01K
Oxygen	10.3K	4.81K
N_2 Air	10.K	4.51K
Freon 22	8.5K	3.01K
Freon 12	8.2K	2.71K
D2	7.3K	1.81K
CH_4	6.4K	.91K

NOTE: To use this feature requires the removal of a jumper internal to the 275 Mini-Convectron.

To remove the jumper proceed as follows:

1. Disassemble the module as per page 6-2.
2. Locate the 22 AWG bare wire jumper along the top edge of the P.C. board labeled "JUMPER".
3. Clip out the jumper.
4. Reassemble the Mini-Convectron.



5-2 Bridge Analog Output Voltage (Vdc) vs Pressure

(1 mTorr - 100 mTorr, N_2)

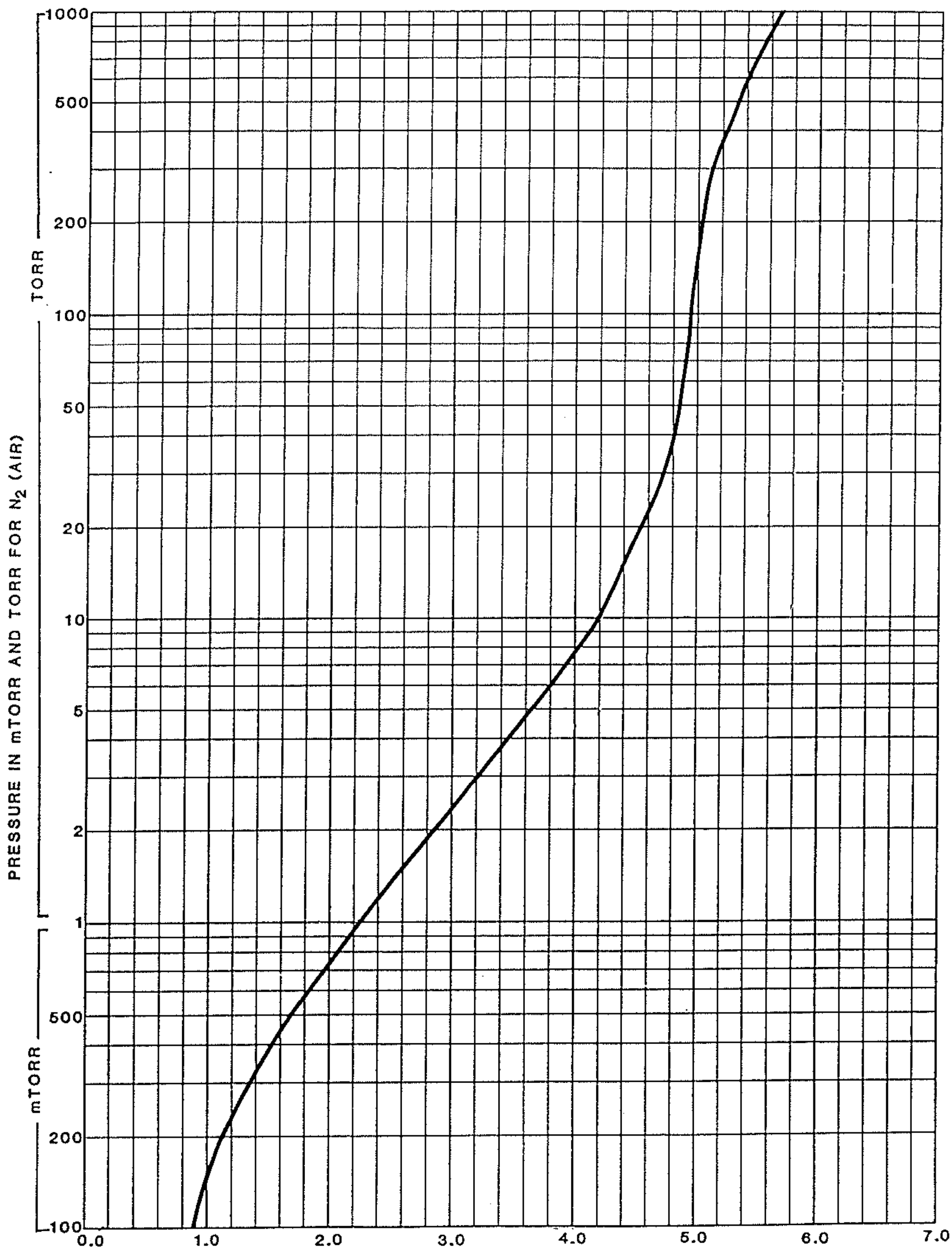


Fig. 5-3 Bridge Analog Output Voltage (Vdc) vs Pressure

(100 mTorr - 1000 Torr, N_2)

True Pressure Torr/mTorr	N_2 (Air)	Argon	Helium	O_2	CO_2	KR	Freon12	Freon22	D2	Ne	CH_4
0	.375	.375	.375	.375	.375	.375	.375	.375	.375	.375	.375
.1 mTorr	.376	.3757	.3755	.376	.376	.3755	.376	.376	.376	.3757	.3766
.2 mTorr	.377	.376	.3765	.377	.377	.3768	.378	.378	.377	.3763	.3780
.5 mTorr	.379	.378	.379	.380	.381	.3772	.382	.381	.381	.3782	.3825
1 mTorr	.384	.381	.382	.384	.385	.379	.388	.388	.386	.381	.3896
2 mTorr	.392	.387	.389	.392	.395	.384	.401	.400	.396	.388	.403
5 mTorr	.417	.403	.409	.417	.412	.395	.437	.432	.425	.405	.438
10 mTorr	.455	.429	.441	.453	.462	.415	.488	.480	.470	.433	.492
20 mTorr	.523	.477	.497	.521	.536	.451	.581	.566	.549	.484	.584
50 mTorr	.682	.595	.637	.679	.705	.544	.778	.764	.727	.608	.796
100 mTorr	.878	.745	.814	.868	.900	.668	1.009	.990	.944	.768	1.053
200 mTorr	1.155	.962	1.068	1.141	1.179	.847	1.315	1.291	1.265	1.002	1.392
500 mTorr	1.683	1.386	1.589	1.664	1.668	1.194	1.826	1.805	1.914	1.469	2.014
1 Torr	2.217	1.818	2.164	2.195	2.172	1.536	2.257	2.247	2.603	1.976	2.632
2 Torr	2.842	2.333	2.939	2.814	2.695	1.921	2.647	2.666	3.508	2.631	3.313
5 Torr	3.675	3.028	4.387	3.672	3.316	2.429	3.029	3.090	5.059	3.715	-
10 Torr	4.206	3.480	5.774	4.225	3.670	2.734	3.204	3.330	6.361	4.605	4.699
20 Torr	4.577	3.801	7.314	4.620	3.903	2.966	3.308	3.414		5.406	5.172
50 Torr	4.846	4.037		4.916	4.071	3.075	3.430	3.509		6.159	5.583
100 Torr	4.945	4.122		5.026	4.154	3.134	3.618	3.660		6.483	5.720
200 Torr	5.019	4.192		5.106	4.336	3.269	3.827	3.883		6.661	5.860
300 Torr	5.111	4.283		5.200	4.502	3.384	3.938	4.005		6.726	-
400 Torr	5.224	4.386		5.315	4.621	3.466	4.016	4.088		6.767	6.103
500 Torr	5.329	4.477		5.422	4.708	3.526	4.076	4.151		6.803	-
600 Torr	5.419	4.550		5.515	4.775	3.573	4.124	4.203		6.843	6.342
700 Torr	5.495	4.611		5.592	4.830	3.613	4.166	4.247		6.890	-
760 Torr	5.534	4.643		5.633	4.860	3.632	4.190	4.271		6.920	-
800 Torr	5.558	4.663		5.658	4.877	3.645	4.203	4.286		6.942	6.519
900 Torr	5.614	4.706		5.713	4.919	3.674	4.237	4.321		7.000	-
1000 Torr	5.659	4.745		5.762	4.955	-	4.270	4.354		7.056	6.642

Fig. 5-4 Bridge Analog Output Voltage (Vdc) for Various Gases

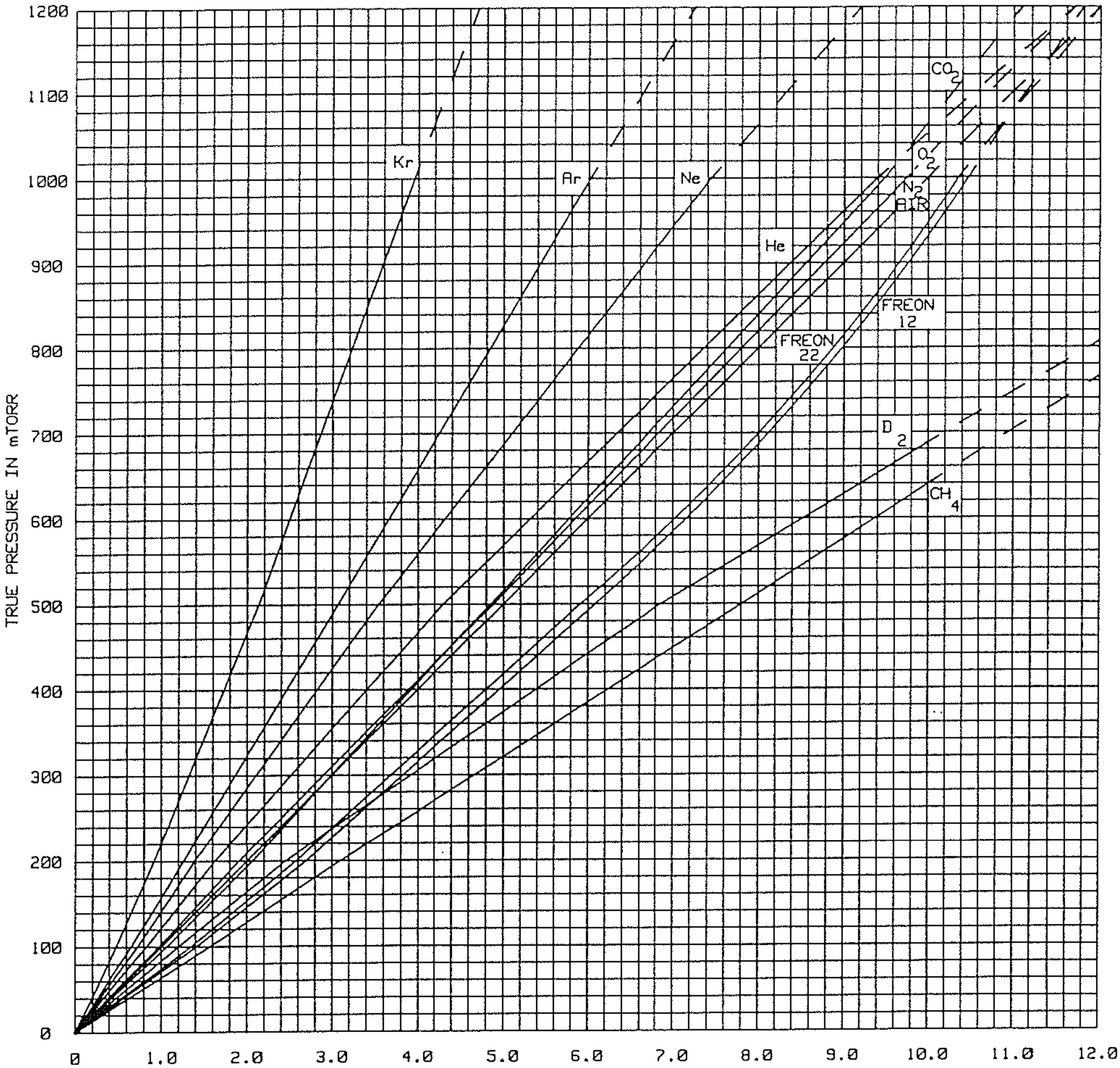


Fig. 5-5 Linear Analog Output Voltage (Vdc) vs Various Gases

NOTES

CHAPTER 6

MAINTENANCE

General Information

Although the Mini-Convectron was designed using as many commonly available components as possible, thus allowing easy service, it is still recommended that only qualified technical personnel attempt repairs.

Should difficulties be encountered in the use of your Mini-Convectron, the following list of symptoms and remedies, along with the schematics, can prove useful in quickly getting back into operation. Since the majority of parts are readily available at local electronics supply stores, it may, in some cases, prove most expedient for you to repair minor troubles should they occur.

If the prescribed remedies do not correct the troubles, or if additional assistance or special parts are required, contact the Technical Service Department, Granville-Phillips Company, 5675 East Arapahoe Avenue, Boulder, Colorado, 80303. Telephone: (303)-443-7660. Repairs properly made with equivalent electronic parts and rosin core solder, which do not damage other portions of the unit, do not represent a violation of the warranty.

Check the following list for the observed symptoms. This listing of symptoms and remedies is not complete, but should be sufficient to solve most problems. <u>All possible causes of failure should be thoroughly explored before attempting any component replacement</u>.

Guidelines

Since the Mini-Convectron contains static-sensitive electronic parts, the following precautions must be followed when troubleshooting:

1) Use a grounded, conductive work surface.

2) Use static dissipative envelopes to store or ship printed circuit boards.

3) **Do not** handle the printed circuit board more than absolutely necessary, and only when wearing a ground strap.

4) **Do not** use an ohmmeter for troubleshooting. Rely on voltage measurements.

5) Use grounded-type soldering irons only.

Mini-Convectron Disassembly

For most troubleshooting procedures it will be required that the printed circuit board and gauge tube be removed from the enclosure. To accomplish this proceed as follows:

1. Remove eight screws holding on the end plates and the two "D" connector jack screws.

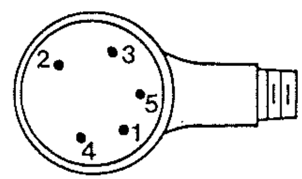
2. Separate the top and bottom chassis and remove the printed circuit board/transducer assembly.

3. To remove the gauge tube from the PC board simply unplug from the four sockets on the board.

4. For assembly, reverse this procedure.

For troubleshooting, a 9 pin "D" connector with only the input power and ground connected will be most useful.

SYMPTOM	POSSIBLE CAUSE	REMEDY
1. Analog output voltage reads zero Vdc.	1. No input power. Verify that there is +13 Vdc to +16 Vdc at pin 3 of the I/O connector with respect to pin 4.	Correct reason for lack of input power.
2. Bridge analog output voltage reads less than +0.22 Vdc or greater than +10 Vdc.	1. Gauge tube failure. Test for gauge tube failure. Measure the resistance between the following terminals with the gauge tube at atmospheric pressure and an ohmmeter which can not apply more than 10 mA.	Replace gauge tube.



1 to 2: 20 to 30 ohms
2 to 3: 50 to 60 ohms
1 to 5: 175 to 190 ohms

Note: If the resistance from pins 1 to 2 reads about 800 ohms, the sensor wire in the gauge tube is broken.

	2. Bridge amplifier failure. All of this circuitry is located on the small PC board that the gauge tube plugs into. Check for input power to this board across the two outside fingers of the small board where it is soldered into the large board. Check that the bridge output voltage between the middle finger and the bottom finger is approximately 6 Vdc with the gauge tube at atmosphere.	Troubleshoot and repair.

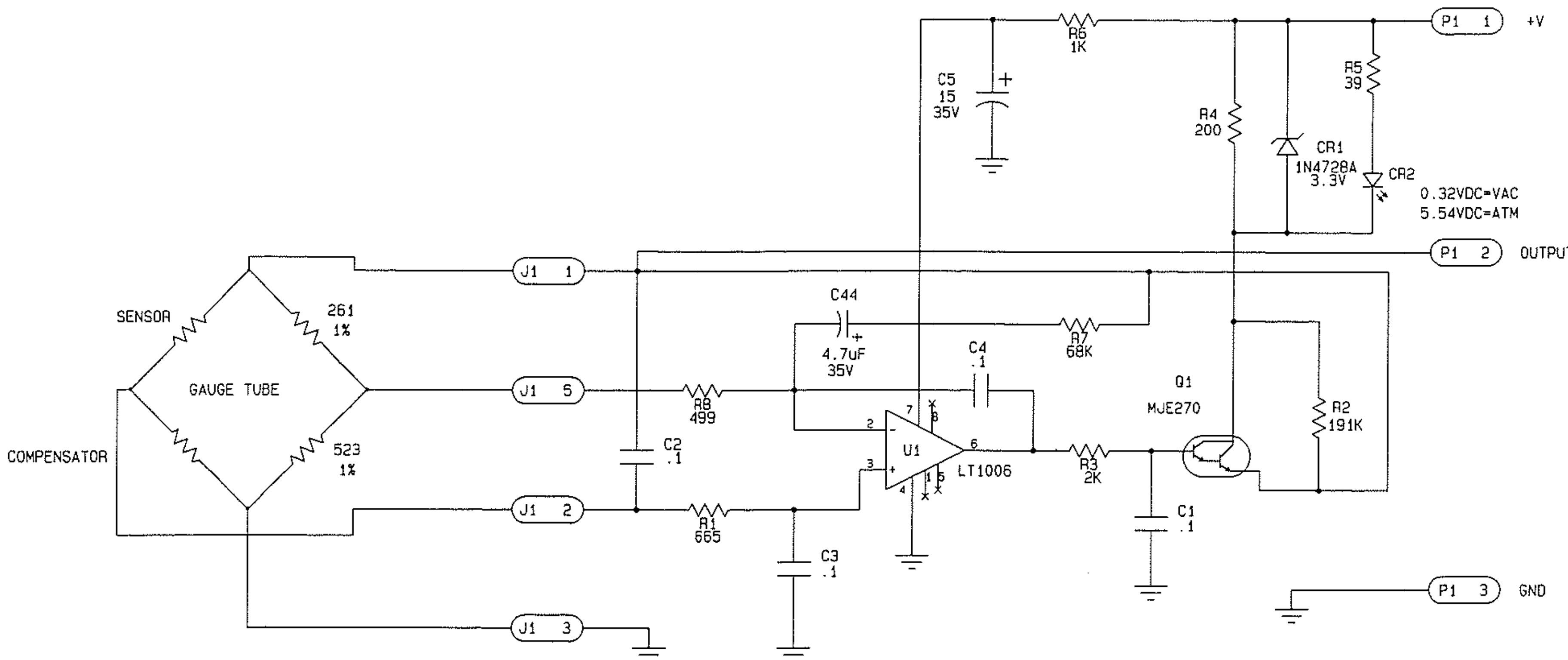
SYMPTOM	POSSIBLE CAUSE	REMEDY
	3. Signal conditioner circuit failure. If the bridge output voltage is correct the amplifier stage U2 and associated circuitry should be checked.	Troubleshoot and repair.
3. Analog output voltages are not as shown in Fig. 5-4.	1. Gauge tube contaminated with material from vacuum system.	Clean gauge tube. If not effective replace the gauge tube.

Cleaning **Note:** Prior to cleaning, the gauge tube must be removed from the electronics as described on page 3-2. Cleaning solvents can damage electronic components or the enclosure.

When the fine sensor wire is so contaminated with oil or other films that its emissivity is appreciably altered, a change of calibration will result. Cleaning with trichloroethylene, perchloroethylene, toluene, or acetone is possible but it must be done very carefully so as not to damage the sensor. **CAUTION:** The fumes from any of these solvents can be dangerous to your health if inhaled and they should be used in well ventilated areas exhausted to the outdoors. Acetone and toluene are highly flammable and should be used away from open flame or electrical equipment. Hold the tube with the main body horizontal and the port projecting upward at an angle of 45° and slowly fill it with solvent using a standard wash bottle with the spout inserted in the port to where it touches the screen. Let the solvent stand in the tube for at lease ten minutes. Do not shake the tube if the tube is only partially filled as liquid forces on the sensor can become large enough to affect the transducer calibration. If the tube is completely filled, shaking is not helpful. To drain the tube, position it horizontally with the port facing downward. By slightly warming the tube, a positive pressure will build up internally forcing the solvent out past the screen. Then allow the tube to dry overnight with the port vertically downward and uncapped. Be certain no solvent odor remains before reinstalling tube on system.

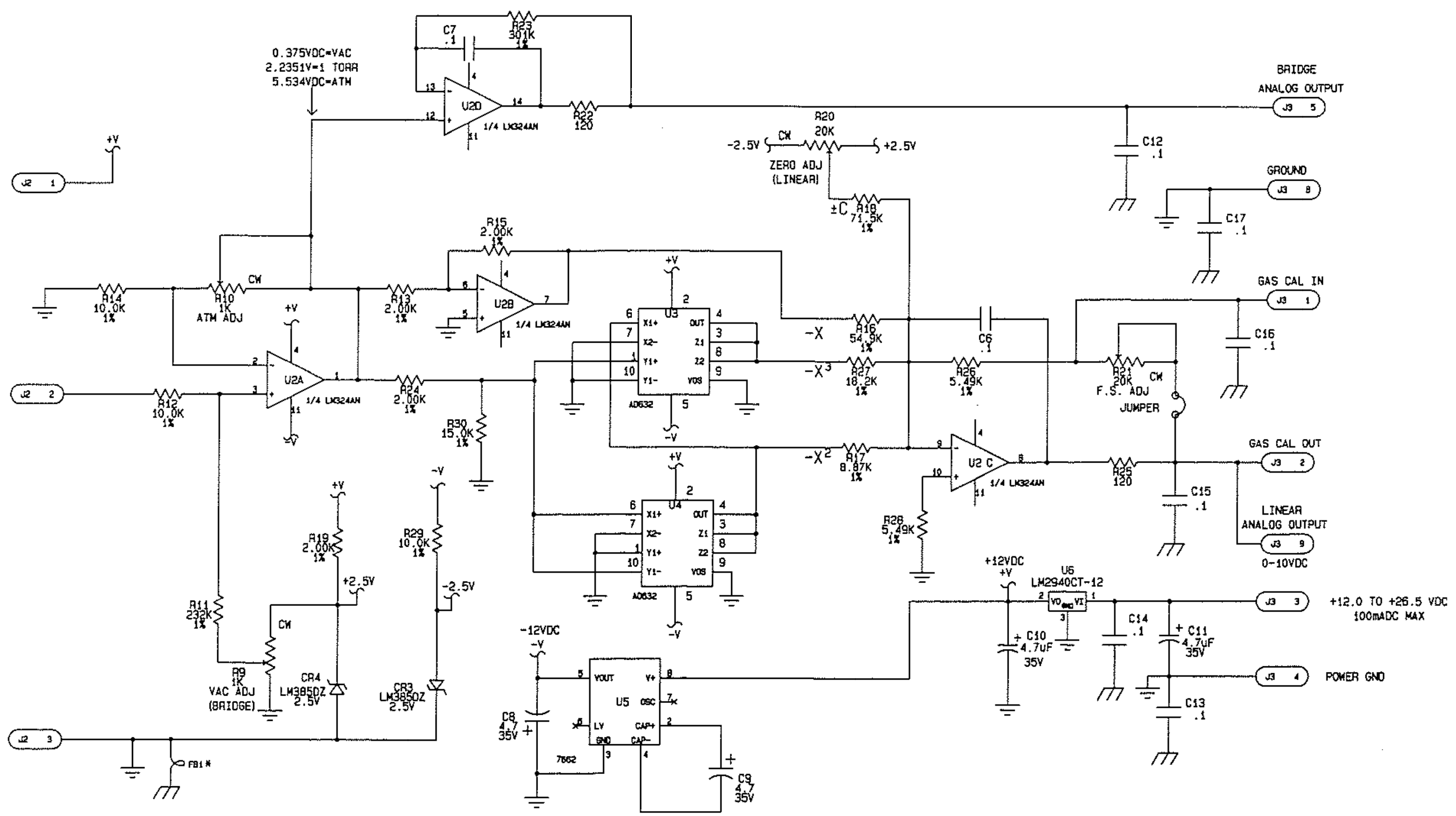
SYMPTOM	POSSIBLE CAUSE	REMEDY
	2. The gold plating on sensor has been attacked by a gas such as fluorine or mercury vapor changing its emissivity and/or resistance.	Replace the gauge tube. Cleaning cannot solve this problem.

SYMPTOM	POSSIBLE CAUSE	REMEDY
4. Analog output voltage indicating a pressure in system vastly different than being observed by other gauges.	1. Gas composition on system not what user believes it to be. This can be caused by selective gas pumping, process in use, outgassing of product, etc.	Determine gas composition and calibrate accordingly.



NOTES: 1. ALL RESISTORS ARE IN OHM, 5%, 1/4W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN uF, 100V UNLESS OTHERWISE SPECIFIED.

FIG. 6-1 SCHEMATIC, 275 BRIDGE AMPLIFIER



NOTES 1. ALL RESISTORS ARE IN OHMS, 5%, 1/4W UNLESS OTHERWISE SPECIFIED.
2. ALL CAPACITORS ARE IN MICROFARADS, 100V UNLESS OTHERWISE SPECIFIED.
3. * NOT USED

FIG. 6-2 SCHEMATIC, SIGNAL CONDITIONER & LINEARIZING CIRCUITRY

NOTES